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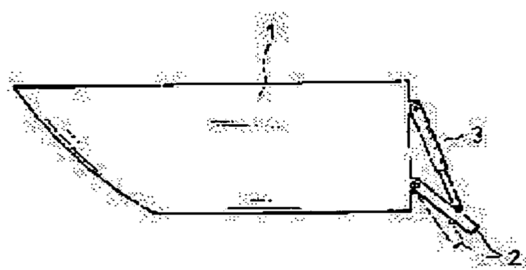
(54) PITCH ANGLE CONTROL DEVICE OF MOTOR BOAT

(57)Abstract:
PROBLEM TO BE SOLVED: To stabilize the position of a hull relative to the lift of a stem which is varied according to various conditions.
SOLUTION: A pitch angle sensor to detect the pitch angle of a hull 1 is fitted, the detected value by the pitch angle sensor is corrected according to the acceleration of the hull 1, and the angle of a flap 2 fitted by a cylinder 3 to a stem in an oscillating manner in the vertical direction is controlled from the corrected pitch angle and the target pitch angle obtained according to the ship speed. In the accelerating condition, the control frequency is increased to control the flap 2 according to the change in the pitch angle, while in the sudden deceleration, the control of the flap 2 is stopped. In addition, a plurality of target pitch angles can be set, and one of them can be selected.



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CLAIMS

[Claim(s)]
[Claim 1] A helix-angle control unit of a motorboat characterized by providing the following. A flap driving means as for which a flap rockable in the vertical direction changes an angle of installation and this flap to the stern A speed sensor which detects vessel speed A helix-angle detection sensor which detects a helix angle of a ship A control means which controls said flap driving means according to an aim helix-angle map means to ask for an aim helix angle according to vessel speed, an acceleration operation means to ask for acceleration from said vessel speed, a detection helix-angle amendment means to amend a helix angle detected by helix-angle detection sensor according to acceleration, and to ask for an amendment helix angle, and said aim helix angle and said amendment helix angle
[Claim 2] A helix-angle control unit of a motorboat according to claim 1 characterized by having a control frequency modification means to change control frequency of said flap driving means according to said acceleration.
[Claim 3] A helix-angle control unit of a motorboat according to claim 1 characterized by having a control means for stopping which judges whether said acceleration is a sudden slowdown, and suspends control of said flap driving means when it is a sudden slowdown.
[Claim 4] Said aim helix angle is the helix-angle control unit of a motorboat according to claim 1 characterized by having a selection means which can carry out a multi-statement and can choose any of these they are.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the trim of the length of a motorboat, i.e., a helix-angle control unit.
[0002]
[Description of the Prior Art] Conventionally, as for a motorboat, a bow will be raised in a hump condition and a skid condition. The amount of lifting of this bow (helix angle) changes according to various conditions, such as vessel speed, crew's manpower, an amount of the load which and was loaded, and a residue of the carried fuel. [embarkation]
[0003]
[Problem(s) to be Solved by the Invention] As mentioned above, the amount of lifting of a bow changes according to various conditions.
[0004] The object of this invention is stabilizing the position of a hull in view of the above-mentioned technical problem according to various conditions.
[0005]
[Means for Solving the Problem] A configuration by which it is characterized [of this invention for attaining the above-mentioned object] A flap driving means as for which a flap rockable in the vertical direction changes an angle of installation and this flap to the stern, A speed sensor which detects vessel speed, and a helix-angle detection sensor which detects a helix angle of a ship, An aim helix-angle map means to ask for an aim helix angle according to vessel speed, and an acceleration operation means to ask for acceleration from said vessel speed, It has a control means which controls said flap driving means according to a detection helix-angle amendment means to amend a helix angle detected by helix-angle detection sensor according to acceleration, and to ask for an amendment helix angle, and said aim helix angle and said amendment helix angle.
[0006] Moreover, in the above-mentioned configuration, it has a control frequency modification means to change control frequency of said flap driving means according to acceleration, and has **.
[0007] Furthermore, in the above-mentioned configuration, it judges whether acceleration is a sudden slowdown, and when it is a sudden slowdown, it has a control means for stopping which suspends control of said flap driving means.
[0008] Moreover, said aim helix angle can carry out a multi-statement, and is equipped with a selection means which can choose any of these they are.
[0009]
[Embodiment of the Invention] The gestalt of operation of this invention is explained based on a drawing below. In drawing 1 , 1 is the hull of a motorboat and 2 is the flap attached in the vertical direction rockable at the stern. This flap 2 is turned to right and left of the stern by the couple. 3 is a cylinder (flap driving means) to which the angle of said flap 2 is changed.
[0010] As drawing 2 shows as a control means which controls said cylinder 3, each and the pump 10 of Cylinders 3R and 3L of a couple are connected through Bulbs 11R and 11L, and these bulbs 11R and 11L perform control of advance, a back space, and an attitude halt for said

cylinders 3R and 3L by the command of a central processing unit 13.
[0011] The cylinder location detecting signal of the cylinder location sensors 12R and 12L which detects the stroke location of each cylinder of said cylinders 3R and 3L, the vessel speed detecting signal of the speed sensor 14 which detects the vessel speed of a hull 1, and the helix-angle detecting signal of the helix-angle sensor 15 of a hull which is attached in a hull 1 and detects the helix angle of a hull 1 are inputted into said central processing unit 13. Said speed sensor 14 is constituted by the rate-of-flow detection by the hydraulic turbine, the Pitot tube, or the engine speed sensor, and the tilt-angle sensor which measures dip is used for said helix-angle sensor 15.
[0012] Furthermore, the selecting switch 17 (selection means) is connected to the above-mentioned central processing unit 13.
[0013] Moreover, the helix-angle amendment map (drawing 4) which asks ROM of **** of the central processing unit 13 above-mentioned internal organs for an aim helix-angle map (drawing 3), acceleration an, and helix-angle P'n to amendment pitch P″n which calculates aim helix-angle Po from vessel speed Vn, the processing program (drawing 5) mentioned later are memorized. In addition, it asks for the above-mentioned aim helix-angle map (drawing 3) and a helix-angle amendment map (drawing 4) by experiment etc. beforehand.
[0014] Said selecting switch 17 is a switch which can choose aim helix-angle Po as it according to position mode or fuel consumption mode since aim helix-angle Po changes with the position mode in which a degree of comfort is thought as important, or fuel consumption modes in which a fuel is thought as important, although the position of a hull 1 is determined. If 17a of this selecting switch 17 is chosen, it will become position mode, and if switch 17b is chosen from the dotted line S of drawing 3 , it will become fuel consumption mode and aim helix-angle Po according to vessel speed Vn will be calculated from the continuous line N of drawing 3 . In addition, it asks for the aim helix angle in each of these modes by experiment etc. beforehand.
[0015] In this example, the impact which receives this position mode from the water surface compared with fuel consumption mode even if aim helix-angle Po is small set up compared with fuel consumption mode and vessel speed Vn increases becomes small. Moreover, by enlarging the amount of lifting of a hull compared with position mode, a hull 1 can lessen resistance received from the water surface, and fuel consumption of fuel consumption mode improves.
[0016] In the above configuration, the flow chart of drawing 5 explains helix-angle control of a flap 2 in the condition of 17a of said selecting switch 17 having been chosen, and having been set as position mode. In addition, repeat activation of this flow chart is carried out at intervals of predetermined time.
[0017] At step 20, vessel speed Vn is read from the speed sensor 14. Next, it asks for the aim helix-angle map Po corresponding to vessel speed Vn from the dotted line S of an aim helix-angle map (drawing 3) at step 22. And helix-angle P'n detected by the helix-angle sensor 15 is read at step 24. Next, acceleration an is calculated by step 26 from speed Vn-1 of the speed Vn (current speed) read by step 20, and 1 time ago.
[0018] At step 28, since the tilt-angle sensor which detects dip as a helix-angle sensor 15 is used, the sensor itself is influenced by change of the acceleration an of a hull 1, and since a different detecting signal from the position of the actual hull 1 is outputted, processing which amends helix-angle P'n detected by the helix-angle sensor 15 is performed. This processing asks for amendment helix-angle P″ n from the acceleration an and the helix-angle amendment map (drawing 4) for which it asked by said step 26.
[0019] Steps 30 and 32 which are degrees are steps which control a flap 2, and it is judged in step 30 whether it is larger than the absolute value alpha of the value which lengthened amendment helix-angle P″ n for which it asked at step 28 from aim helix-angle Po calculated at step 22 (the value of this alpha is a threshold beforehand calculated by experiment etc. in order to judge whether the helix angle of a hull 1 is in a convergence condition). By this judgment, when judged with |Po-P″ n|>alpha (the helix angle of a hull 1 is not in a convergence condition), it is set to Yes, and it shifts to the following step 32.
[0020] At step 32, it asks for the deflection theta of helix-angle Po calculated at step 22, and amendment helix-angle P″ n for which it asked at step 28, i.e., a helix-angle difference, and asks

for the relation of the stroke location of the cylinder 3 according to this helix-angle difference theta from the map of ****, and a flap 2 is positioned at a predetermined angle.
[0021] When the judgment of the above-mentioned step 30 is judged to be No (helix-angle control of a hull 1 is in a convergence condition), control of a flap 2 is not performed.
[0022] Next, in addition to the control of drawing 5 mentioned above, the flow chart of drawing 6 explains what can control the helix angle of a flap 2 so that the position of a hull 1 may be more stable also in the time of sudden acceleration. In addition, repeat activation of this flow chart is carried out at intervals of predetermined time. Since steps 40-48 are the same as steps 20-28 of the flow chart of drawing 5 mentioned above, explanation is omitted.
[0023] Steps 50-56 perform processing which changes the control frequency of a flap 2 at the time of sudden acceleration, and stabilize the position of the hull 1 at the time of sudden acceleration by this processing.
[0024] In said step 50, it asks for an acceleration coefficient k from the acceleration an for which it asked at the acceleration coefficient map which asks for an acceleration coefficient k from the acceleration an shown in drawing 7 , and step 46.
[0025] In this example, it is alike, therefore the value of K decreases two-dimensional, and the acceleration coefficient map (drawing 7) is the map whose acceleration an increases in the state of plus of acceleration an (acceleration condition) and on which acceleration an serves as constant value K in the state of minus (slowdown condition).
[0026] Next, it asks for the weighted average of amendment helix-angle P″ n for which it asked at step 48 by step 52 by the degree type.
[Equation 1]

$$P'''n = \frac{(k-1)\,P'''n_{-1} + P''n}{k} \quad \cdots (1)$$

P″ n is the weighted average of amendment helix-angle and P″amendment helix-angle P which calculated 'n-1 1 time ago″ n among the above-mentioned (1) type.
[0027] By the above-mentioned (1) formula, since the population parameter of a weighted average of amendment helix-angle P″ n is changed according to acceleration an When acceleration an is large (at the time of sudden acceleration), flattery of a flap 2 becomes quick, and when acceleration an is small, amendment helix-angle P ″weighted average P of n″'n (henceforth weighted average P″') which considered the control frequency of a flap 2 is called for so that flattery of a flap 2 may become blunt. Here, the acceleration an of an acceleration coefficient map (drawing 7) serves as acceleration coefficient k=K (constant value) for blunting flattery of a flap 2 at the time of a slowdown in the state of minus.
[0028] In addition, it asks for these acceleration coefficient map (drawing 7) by experiment etc. beforehand, and it is memorized with the above-mentioned (1) formula to said ROM of built-in in said central processing unit 13.
[0029] Steps 54 and 56 which are degrees are steps which drive a flap 2, and it is judged in step 54 whether the absolute value of the value which lengthened weighted average P″'n for which it asked at step 52 from aim helix-angle Po calculated at step 42 is larger than the set point alpha (the value of this alpha is a threshold beforehand calculated by experiment etc. in order to judge whether the helix angle of a hull 1 is in a convergence condition). By this judgment, when judged with |Po-P″ n|>alpha (the helix angle of a hull 1 is not in a convergence condition), it is set to Yes, and it shifts to the following step 56.
[0030] At step 56, it asks for the deflection theta of aim helix-angle Po calculated at step 42, and weighted average P″'n for which it asked at step 52, i.e., a helix-angle difference, and asks for the relation of the stroke location of the cylinder 3 according to this helix-angle difference theta from the map of ****, and a flap 2 is positioned at a predetermined angle.
[0031] When the judgment of the above-mentioned step 54 is judged to be No (the helix angle of a hull 1 is in a convergence condition), control of a flap 2 is not performed.
[0032] Furthermore, in addition to control of above-mentioned drawing 5 , the flow chart of

drawing 8 explains what can control a flap 2 so that the position of a hull 1 is more stable also in the time of a sudden slowdown. In addition, repeat activation of this flow chart is carried out at intervals of predetermined time.
[0033] Since steps 60-68 are the same as steps 20-28 of the flow chart of drawing 5 mentioned above, explanation is omitted.
[0034] In step 70, the size of the acceleration an calculated at step 66 and the predetermined acceleration ao (this predetermined acceleration ao is a threshold for judging with the sudden slowdown for which it asked by experiment etc. beforehand) is judged. In addition, this predetermined acceleration ao is beforehand memorized to said ROM of built-in in said central processing unit 13.
[0035] Here, it is smaller than the predetermined acceleration ao, or acceleration an judges it as a sudden slowdown, in being the same, and it ends processing, without driving a flap 2. Moreover, when acceleration an is larger than the predetermined acceleration ao, it shifts to step 72.
[0036] Steps 72 and 74 which are degrees are steps which control a flap 2, and it is judged in step 72 whether the absolute value of the value which lengthened amendment helix-angle P″ n for which it asked at step 68 from aim helix-angle Po calculated at step 62 is larger than the set point alpha (the value of this alpha is a threshold beforehand calculated by experiment etc. in order to judge whether the helix angle of a hull 1 is in a convergence condition). By this judgment, when judged with |Po-P″ n|>alpha (the helix angle of a hull 1 is not in a convergence condition), it is set to Yes, and it shifts to the following step 74. In addition, this set point alpha is beforehand memorized to said ROM of built-in in said central processing unit 13.
[0037] At this step 74, it asks for the deflection theta of aim helix-angle Po calculated at step 62, and amendment helix-angle P″ n for which it asked at step 68, i.e., a helix-angle difference, and asks for the relation of the stroke location of the cylinder 3 according to this helix-angle difference theta from the map of ****, and a flap 2 is positioned at a predetermined angle.
[0038] When the judgment of the above-mentioned step 72 is judged to be No (the helix angle of a hull 1 is in a convergence condition), control of a flap 2 is not performed.
[0039] Since detection helix-angle P'n of the helix-angle sensor 15 which detects the helix angle of a hull 1 is amended in this example according to the acceleration an of a hull 1 as stated above, an unnecessary motion of a flap 2 can be suppressed and a hull 1 is stable.
[0040] Moreover, in this example, since a flap 2 is [the control frequency of a flap 2] quickly controllable according to raising and change of the helix angle Pn of a hull 1 at the time of sudden acceleration, the hull 1 at the time of sudden acceleration can be stabilized. Moreover, since control frequency falls and a flap 2 is dully controlled except the time of sudden acceleration, oil-temperature lifting of a hydraulic circuit can also be prevented.
[0041] Furthermore, in this example, since control of a flap 2 is stopped at the time of a sudden slowdown and a flap 2 is not moved in the condition that a hull 1 is not stabilized, the hull 1 at the time of a sudden slowdown can be stabilized.
[0042] Moreover, in this example, since the multi-statement of the aim helix-angle Po of a hull 1 can be carried out and one of these can be chosen, the NAV according to liking is attained.
[0043]
[Effect of the Invention] Since according to this invention the detection helix angle of a helix-angle sensor is amended according to acceleration, the effect the helix-angle sensor itself is influenced by change of acceleration is removed, as stated above, and the flap was controlled based on the deflection of this amended helix angle and the aim helix angle according to vessel speed, the position of a hull can be stabilized more.
[0044] Moreover, since a flap is controlled to answer raising and change of the helix angle of a hull quickly in the control frequency of a flap at the time of acceleration, the shake of the hull at the time of acceleration can be prevented.
[0045] Furthermore, since control of a flap is suspended in the condition that the hull is not stable like a sudden slowdown, the shake of the hull of a sudden slowdown can be prevented.
[0046] Moreover, since the multi-statement of the position of a hull can be carried out and one of these can be chosen, the NAV which suited liking of NAV conditions, such as long-distance navigation, and a navigation person is attained.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to the trim of the length of a motorboat, i.e., a pitch angle control unit.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Conventionally, as for a motorboat, a bow will be raised in a hump condition and a skid condition. The amount of lifting of this bow (pitch angle) changes according to various conditions, such as vessel speed, crew's number, an amount of the load which and was loaded, and a residue of the carried fuel. [boarding]

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] Since according to this invention the detection pitch angle of a pitch angle sensor is amended according to acceleration, the effect the pitch angle sensor itself is influenced by change of acceleration is removed, as stated above, and the flap was controlled based on the deflection of this amended pitch angle and the target pitch angle according to vessel speed, the posture of a hull can be stabilized more.
[0044] Moreover, the control frequency of a flap is raised at the time of acceleration, and since a flap is controlled to answer change of the pitch angle of a hull quickly, the shake of the hull at the time of acceleration can be prevented.
[0045] Furthermore, since control of a flap is suspended in the condition that the hull is not stable like sudden moderation, the shake of the hull of sudden moderation can be prevented.
[0046] Moreover, since the multi-statement of the posture of a hull can be carried out and one of these can be chosen, the NAV which suited liking of NAV conditions, such as long-distance navigation, and a navigation person is attained.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] As mentioned above, the amount of lifting of a bow changes according to various conditions.
[0004] The purpose of this invention is stabilizing the posture of a hull in view of the above-mentioned technical problem according to various conditions.

[Translation done.]

MEANS

[Means for Solving the Problem] The configuration by which it is characterized [of this invention for attaining the above-mentioned purpose] The flap driving means which a rockable flap is attached [driving means] in the vertical direction and changes the include angle of this flap to the stern, The rate sensor which detects vessel speed, and the pitch angle detection sensor which detects the pitch angle of a ship, A target pitch angle map means to ask for a target pitch angle according to vessel speed, and an acceleration operation means to ask for acceleration from said vessel speed, It has the control means which controls said flap driving means according to a detection pitch angle amendment means to amend the pitch angle detected by the pitch angle detection sensor according to acceleration, and to ask for an amendment pitch angle, and said target pitch angle and said amendment pitch angle.
[0006] Moreover, in the above-mentioned configuration, it has a control frequency modification means to change the control frequency of said flap driving means according to acceleration, and has **.
[0007] Furthermore, in the above-mentioned configuration, it judges whether acceleration is sudden moderation, and when it is sudden moderation, it has the control means for stopping which suspends control of said flap driving means.
[0008] Moreover, said target pitch angle can carry out a multi-statement, and is equipped with the selection means which can choose any of these they are.
[0009]
[Embodiment of the Invention] The gestalt of operation of this invention is explained based on a drawing below. In drawing 1 , 1 is the hull of a motorboat and 2 is the flap attached in the vertical direction rockable at the stern. This flap 2 is turned to right and left of the stern by the pair. 3 is a cylinder to which the include angle of said flap 2 is changed.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The side elevation of the motorboat equipped with this invention equipment
[Drawing 2] The circuit diagram of this invention equipment
[Drawing 3] The aim helix-angle map which asks for an aim helix angle
[Drawing 4] The helix-angle amendment map which asks for the amended detection helix angle
[Drawing 5] The flow chart which amends the helix angle according to acceleration
[Drawing 6] The flow chart which changes the control frequency of a flap at the time of acceleration
[Drawing 7] The acceleration coefficient map which asks for an acceleration correction factor
[Drawing 8] The flow chart which suspends control of a flap at the time of a slowdown
[Description of Notations]
1 Hull
2 Flap
3 Cylinder
3R Cylinder
3L Cylinder
10 Pump
11R Bulb
11L Bulb
12R Cylinder location sensor
12L Cylinder location sensor
13 Central Processing Unit
14 Speed Sensor
15 Helix-Angle Sensor
17 Selecting Switch

[Translation done.]

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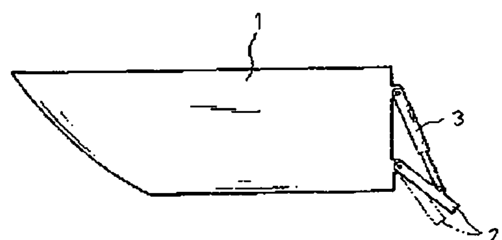
最終頁に続く

(54)【発明の名称】　モータボートのピッチ角制御装置

(57)【要約】

【課題】本発明は、種々の条件に応じて変化する船首の持ち上がり量に対して、船体の姿勢を安定させることである。

【解決手段】船体1のピッチ角を検出するピッチ角センサ15を取り付け、このピッチ角センサの検出値を船体1の加速度に応じて補正し、この補正したピッチ角と、船速に応じて求めた目標ピッチ角から、船尾にシリンダ3によって上下方向に揺動可能に取り付けられたフラップ2の角度の制御を行うようにした。また、加速時には制御頻度を上げピッチ角の変化に応じたフラップ2の制御を行い、急減速時にはフラップ2の制御を停止するようにした。さらに、目標ピッチ角を複数設定でき、そのうちの一つを選択可能とした。



【特許請求の範囲】
【請求項１】 船尾に上下方向に揺動可能なフラップを取り付け、このフラップの角度を変化させるフラップ駆動手段と、船速を検出する速度センサと、船のピッチ角を検出するピッチ角検出センサと、船速に応じて目標ピッチ角を求める目標ピッチ角マップ手段と、前記船速から加速度を求める加速度演算手段と、加速度に応じてピッチ角検出センサにより検出されるピッチ角を補正し補正ピッチ角を求める検出ピッチ角補正手段と、前記目標ピッチ角と前記補正ピッチ角とに応じて前記フラップ駆動手段を制御する制御手段とを備えたことを特徴とするモータボートのピッチ角制御装置。
【請求項２】 前記加速度に応じて前記フラップ駆動手段の制御頻度を変更する制御頻度変更手段を備えたことを特徴とする請求項１に記載のモータボートのピッチ角制御装置。
【請求項３】 前記加速度が急減速であるか否かを判定し，急減速であるとき前記フラップ駆動手段の制御を停止する制御停止手段を備えたことを特徴とする請求項１に記載のモータボートのピッチ角制御装置。
【請求項４】 前記目標ピッチ角は複数設定でき，このうちの何れかを選択できる選択手段を備えたことを特徴とする請求項１に記載のモータボートのピッチ角制御装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は，モータボートの縦のトリム、すなわちピッチ角制御装置に関するものである。
【０００２】
【従来の技術】従来、モータボートはハンプ状態及び滑走状態において船首が持ち上がってしまう。この船首の持ち上がり量（ピッチ角）は船速，乗員の人数，乗船位置，積載した積荷の量，搭載された燃料の残量等種々の条件に応じて変化する。
【０００３】
【発明が解決しようとする課題】上記のように，船首の持ち上がり量は種々の条件に応じて変化する。
【０００４】本発明の目的は、上記の課題に鑑み，種々の条件に応じて船体の姿勢を安定させることである。
【０００５】
【課題を解決するための手段】上記の目的を達成するための本発明の特徴とする構成は、船尾に上下方向に揺動可能なフラップを取り付け，このフラップの角度を変化させるフラップ駆動手段と，船速を検出する速度センサと，船のピッチ角を検出するピッチ角検出センサと、船速に応じて目標ピッチ角を求める目標ピッチ角マップ手段と，前記船速から加速度を求める加速度演算手段と、加速度に応じてピッチ角検出センサにより検出されるピッチ角を補正し補正ピッチ角を求める検出ピッチ角補正手段と、前記目標ピッチ角と前記補正ピッチ角とに応じて前記フラップ駆動手段を制御する制御手段とを備えたものである。
【０００６】また、上記の構成において、加速度に応じて前記フラップ駆動手段の制御頻度を変更する制御頻度変更手段を備えたを備えたものである。
【０００７】さらに、上記の構成において、加速度が急減速であるか否かを判定し，急減速であるとき前記フラップ駆動手段の制御を停止する制御停止手段を備えたものである。
【０００８】また、前記目標ピッチ角は複数設定でき、このうちの何れかを選択できる選択手段を備えたものである。
【０００９】
【発明の実施の形態】以下本発明の実施の形態を図面に基づいて説明する。図１において、１はモータボートの船体であり、２は船尾に上下方向に揺動可能に取り付けたフラップである。このフラップ２は船尾の左右に一対で向けられている。３は前記フラップ２の角度を変化させるシリンダ（フラップ駆動手段）である。
【００１０】前記シリンダ３を制御する制御手段としては図２で示すように，一対のシリンダ３Ｒ，３Ｌのそれぞれとポンプ１０とをバルブ１１Ｒ，１１Ｌを介して接続し，このバルブ１１Ｒ，１１Ｌは中央処理装置１３の指令によって前記シリンダ３Ｒ，３Ｌを前進，後退及び進退停止の制御を行う。
【００１１】前記中央処理装置１３には，前記シリンダ３Ｒ，３Ｌの各シリンダのストローク位置を検出するシリンダ位置センサ１２Ｒ，１２Ｌのシリンダ位置検出信号と，船体１の船速を検出する速度センサ１４の船速検出信号と，船体１に取り付けられ船体１のピッチ角を検出する船体のピッチ角センサ１５のピッチ角検出信号とが入力される。前記速度センサ１４は例えば水車による流速検出，ピトー管あるいはエンジン回転数センサ等により構成され，前記ピッチ角センサ１５には例えば傾斜を測定する傾斜角センサ等が用いられる。
【００１２】さらに，上記中央処理装置１３には選択スイッチ１７（選択手段）が接続されている。
【００１３】また，上記中央処理装置１３内臓の図略のＲＯＭには，船速Ｖｎから目標ピッチ角Ｐｏを求める目標ピッチ角マップ（図３），加速度ａｎ，ピッチ角Ｐ'ｎから補正ピッチＰ"ｎを求めるピッチ角補正マップ（図４）、後述する処理プログラム（図５）等が記憶されている。尚，上記目標ピッチ角マップ（図３），ピッチ角補正マップ（図４）は予め実験等により求める。
【００１４】前記選択スイッチ１７は，船体１の姿勢を決定するのに，乗り心地を重視する姿勢モードか燃料を重視する燃費モードかにより目標ピッチ角Ｐｏが異なるので，姿勢モードか燃費モードに応じて目標ピッチ角Ｐｏを選択できるスイッチである。この選択スイッチ１７

の17aが選択されると姿勢モードとなり図3の点線Sから、また、スイッチ17bが選択されると燃費モードとなり図3の実線Nから船速Vnに応じた目標ピッチ角Poが求められる。尚、これらの各モードの目標ピッチ角は予め実験等により求める。

【0015】この実施例において、この姿勢モードは燃費モードに比べて目標ピッチ角Poが小さく設定されており、船速Vnが増加しても燃費モードに比べて水面から受ける衝撃が小さくなる。また、燃費モードは船体の持ち上がり量を姿勢モードに比べて大きくすることにより、船体1が水面から受ける抵抗を少なくでき燃費が向上する。

【0016】以上の構成において、前記選択スイッチ17の17aが選択され姿勢モードに設定された状態で、フラップ2のピッチ角制御を図5のフローチャートによって説明する。尚、このフローチャートは所定時間間隔で繰り返し実行される。

【0017】ステップ20で、速度センサ14から船速Vnを読み込む。次に、ステップ22で、目標ピッチ角マップ（図3）の点線Sから船速Vnに対応する目標ピッチ角マップPoを求める。そして、ステップ24で、ピッチ角センサ15により検出されるピッチ角P' nを読み込む。次に、ステップ26により、ステップ20により読み込んだ速度Vn（現在速度）と1回前の速度V_{n-1}から加速度anを演算する。

【0018】ステップ28では、ピッチ角センサ15として傾斜を検出する傾斜角センサを使用しているため、センサ自体が、船体1の加速度anの変化による影響を受け、実際の船体1の姿勢とは異なる検出信号を出力してしまうため、ピッチ角センサ15により検出されるピッチ角P' nを補正する処理を行う。この処理は、前記ステップ26により求めた加速度anとピッチ角補正マップ（図4）から補正ピッチ角P" nを求める。

【0019】次のステップ30，32はフラップ2を制御するステップであり、ステップ30において、ステップ22で求めた目標ピッチ角Poからステップ28で求めた補正ピッチ角P" nを引いた値の絶対値α（このαの値は、船体1のピッチ角が収束状態であるか否かを判＊定するため、予め実験等により求めた閾値である）よりも大きいか判定される。この判定により、｜Po－P" n｜＞αと判定（船体1のピッチ角が収束状態ではない）された場合にはYesとなり、次のステップ32に移行する。

【0020】ステップ32では、ステップ22で求めたピッチ角Poとステップ28で求めた補正ピッチ角P" nとの偏差すなわちピッチ角差θを求め、このピッチ角差θに応じたシリンダ3のストローク位置の関係を図略のマップから求め、フラップ2を所定角度に位置決めする。

【0021】上記ステップ30の判定がNoと判定（船体1のピッチ角制御が収束状態である）された場合には、フラップ2の制御は行わない。

【0022】次に、上述した図5の制御に加え、急加速時でも船体1の姿勢がより安定化するように、フラップ2のピッチ角を制御できるものを図6のフローチャートによって説明する。なお、このフローチャートは所定時間間隔で繰り返し実行される。ステップ40～48は、前述した図5のフローチャートのステップ20～28と同じであるので、説明を省略する。

【0023】ステップ50～56は急加速度時にフラップ2の制御頻度を変更する処理を行うもので、この処理により急加速時の船体1の姿勢を安定化する。

【0024】前記ステップ50において、図7に示す加速度anから加速度係数kを求める加速度係数マップとステップ46で求めた加速度anから、加速度係数kを求める。

【0025】この実施例において、加速度係数マップ（図7）は、加速度anがプラスの状態（加速状態）では加速度anが増加するに従ってKの値が2次元的に減少し、加速度anがマイナスの状態（減速状態）では一定値Kとなるようなマップになっている。

【0026】次に、ステップ52により、ステップ48で求めた補正ピッチ角P" nの加重平均を次式により求める。

【数1】

$$P'''_n=\frac{(k-1)P'''_{n-1}+P''_n}{k}\quad\cdots(1)$$

上記（1）式中、P" nは補正ピッチ角、P"' n_{-1}は1回前に演算した補正ピッチ角P" nの加重平均である。

【0027】上記（1）式により、加速度anに応じて補正ピッチ角P" nの加重平均の母数を変化させるので、加速度anが大きい時（急加速時）にはフラップ2の追従が素早くなり、加速度anが小さい時にはフラップ2の追従が鈍くなるように、フラップ2の制御頻度を加味した補正ピッチ角P" nの加重平均P"' n（以下、加重平均P"' という）が求められる。ここで、加速度係数マップ（図7）の加速度anがマイナスの状態で加速度係数k＝K（一定値）となっているのは減速時にフラップ2の追従を鈍くするためである。

【0028】尚、これら加速度係数マップ（図7）は予め実験等により求め、上記（1）式と共に前記中央処理装置13に内蔵の前記ROMに記憶しておく。

【0029】次のステップ54，56はフラップ2を駆動するステップであり、ステップ54において、ステッ

プ42で求めた目標ピッチ角Ｐｏからステップ52で求めた加重平均Ｐ″´ｎを引いた値の絶対値が設定値α（このαの値は、船体1のピッチ角が収束状態であるか否かを判定するため、予め実験等により求めた閾値である）よりも大きいか判定される。この判定により、｜Ｐｏ－Ｐ″ｎ｜＞αと判定（船体1のピッチ角が収束状態ではない）された場合にはＹｅｓとなり、次のステップ56に移行する。

【0030】ステップ56では、ステップ42で求めた目標ピッチ角Ｐｏとステップ52で求めた加重平均Ｐ″´ｎとの偏差すなわちピッチ角差θを求め、このピッチ角差θに応じたシリンダ3のストローク位置の関係を図略のマップから求め、フラップ2を所定角度に位置決めする。

【0031】上記ステップ54の判定がＮｏと判定（船体1のピッチ角が収束状態である）された場合には、フラップ2の制御は行わない。

【0032】さらに、上述の図5の制御に加え、急減速時でも船体1の姿勢がより安定化するようにフラップ2を制御できるものを図8のフローチャートによって説明する。尚、このフローチャートは所定時間間隔で繰り返し実行される。

【0033】ステップ60～68は前述した図5のフローチャートのステップ20～28と同じであるので、説明を省略する。

【0034】ステップ70において、ステップ66で演算した加速度ａｎと所定加速度ａｏ（この所定加速度ａｏは予め実験等により求めた急減速と判定するための閾値である）の大小が判定される。尚、この所定加速度ａｏは予め前記中央処理装置13に内蔵の前記ＲＯＭに記憶しておく。

【0035】ここで、加速度ａｎが所定加速度ａｏより小さいか同じの場合には急減速と判断し、フラップ2の駆動を行わずに処理を終了する。また、加速度ａｎが所定加速度ａｏより大きい場合にはステップ72に移行する。

【0036】次のステップ72，74はフラップ2を制御するステップであり、ステップ72において、ステップ62で求めた目標ピッチ角Ｐｏからステップ68で求めた補正ピッチ角Ｐ″ｎを引いた値の絶対値が設定値α（このαの値は、船体1のピッチ角が収束状態であるか否かを判定するため、予め実験等により求めた閾値である）よりも大きいか判定される。この判定により、｜Ｐｏ－Ｐ″ｎ｜＞αと判定（船体1のピッチ角が収束状態ではない）された場合にはＹｅｓとなり、次のステップ74に移行する。尚、この設定値αは予め前記中央処理装置13に内蔵の前記ＲＯＭに記憶しておく。

【0037】このステップ74では、ステップ62で求めた目標ピッチ角Ｐｏとステップ68で求めた補正ピッチ角Ｐ″ｎとの偏差すなわちピッチ角差θを求め、このピッチ角差θに応じたシリンダ3のストローク位置の関係を図略のマップから求め、フラップ2を所定角度に位置決めする。

【0038】上記ステップ72の判定がＮｏと判定（船体1のピッチ角が収束状態である）された場合には、フラップ2の制御は行わない。

【0039】以上述べたように、本実施例においては、船体1のピッチ角を検出するピッチ角センサ15の検出ピッチ角Ｐ´ｎを船体1の加速度ａｎに応じて補正するので、フラップ2の不必要な動きを抑えることができ、船体1が安定化する。

【0040】また、本実施例においては、急加速時にフラップ2の制御頻度を上げ、船体1のピッチ角Ｐｎの変化に応じてフラップ2を素早く制御できるので、急加速時の船体1を安定化できる。また、急加速時以外は制御頻度が下がりフラップ2を鈍く制御するので、油圧回路の油温上昇も防ぐことができる。

【0041】さらに、本実施例においては、急減速時にフラップ2の制御を停止させるので、船体1が安定しない状態でフラップ2を動かさないため、急減速時の船体1を安定化できる。

【0042】また、本実施例においては、船体1の目標ピッチ角Ｐｏを複数設定でき、このうちの一つを選択できるので、好みに応じた航行が可能となる。

【0043】

【発明の効果】以上述べたように本発明によると、加速度に応じてピッチ角センサの検出ピッチ角を補正して、ピッチ角センサ自体が加速度の変化により受ける影響を取り除き、この補正したピッチ角と船速に応じた目標ピッチ角との偏差に基づいて、フラップを制御するようにしたので、船体の姿勢をより安定化できる。

【0044】また、加速時にはフラップの制御頻度を上げ、船体のピッチ角の変化に素早く応答するようにフラップを制御するので、加速時の船体の揺れを防止できる。

【0045】さらに、急減速のように船体が安定していない状態ではフラップの制御を停止するので、急減速の船体の揺れを防止することができる。

【0046】また、船体の姿勢を複数設定できこのうちの一つを選択できるので、長距離航行等の航行条件や操船者の好みにあった航行が可能となる。

【図面の簡単な説明】

【図1】本発明装置を備えたモータボートの側面図

【図2】本発明装置の回路図

【図3】目標ピッチ角を求める目標ピッチ角マップ

【図4】補正した検出ピッチ角を求めるピッチ角補正マップ

【図5】加速度に応じたピッチ角の補正をするフローチャート

【図6】加速時にフラップの制御頻度を変更するフロー

チャート

【図7】加速度補正係数を求める加速度係数マップ

【図8】減速時にフラップの制御を停止するフローチャート

【符号の説明】

1 船体

2 フラップ

3 シリンダ

3R シリンダ

3L シリンダ

＊10 ポンプ

11R バルブ

11L バルブ

12R シリンダ位置センサ

12L シリンダ位置センサ

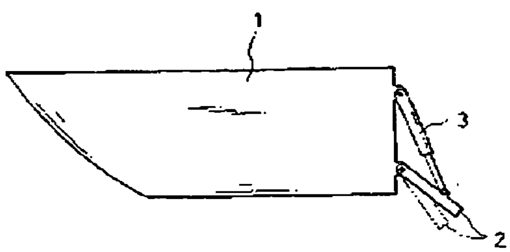
13 中央処理装置

14 速度センサ

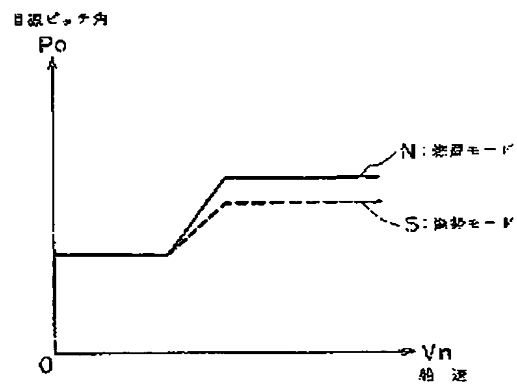
15 ピッチ角センサ

17 選択スイッチ

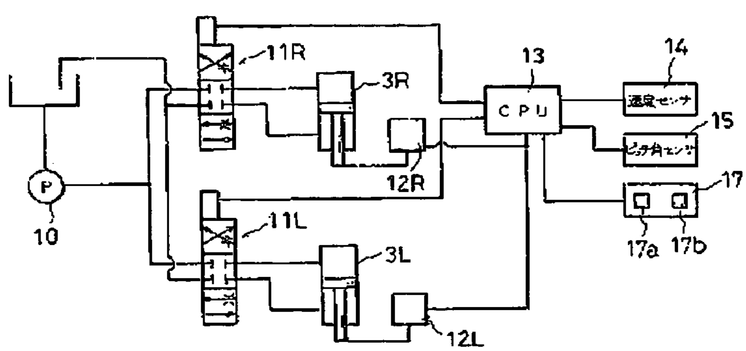
【図1】



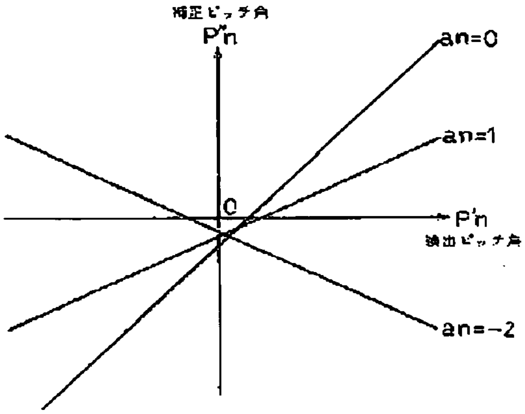
【図3】



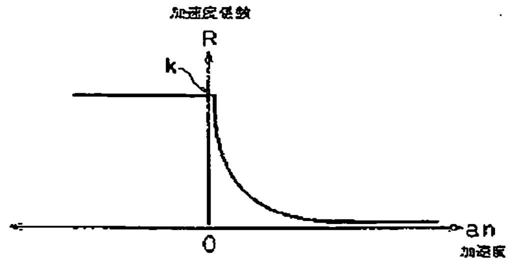
【図2】



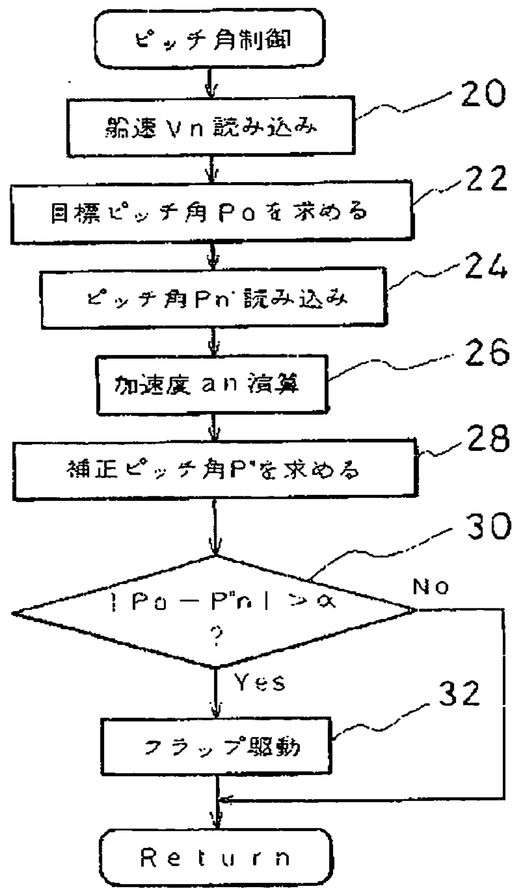
【図4】


補正ピッチ角
P"n
an=0
an=1
0
P'n
検出ピッチ角
an=−2

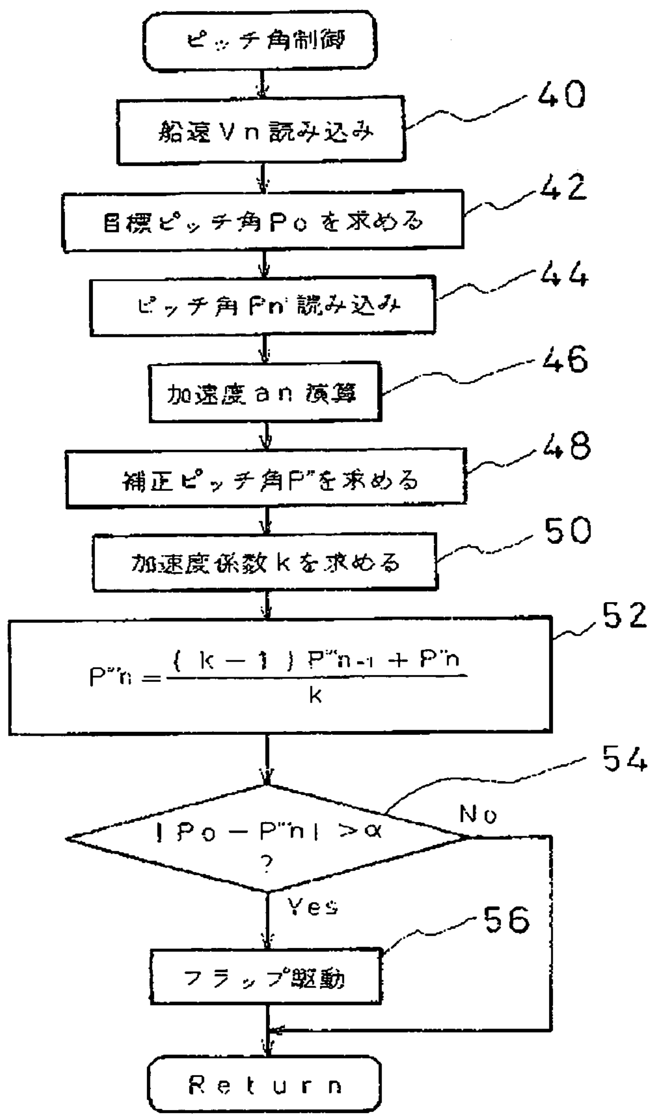
【図7】


加速度係数
R
k
an
0
加速度

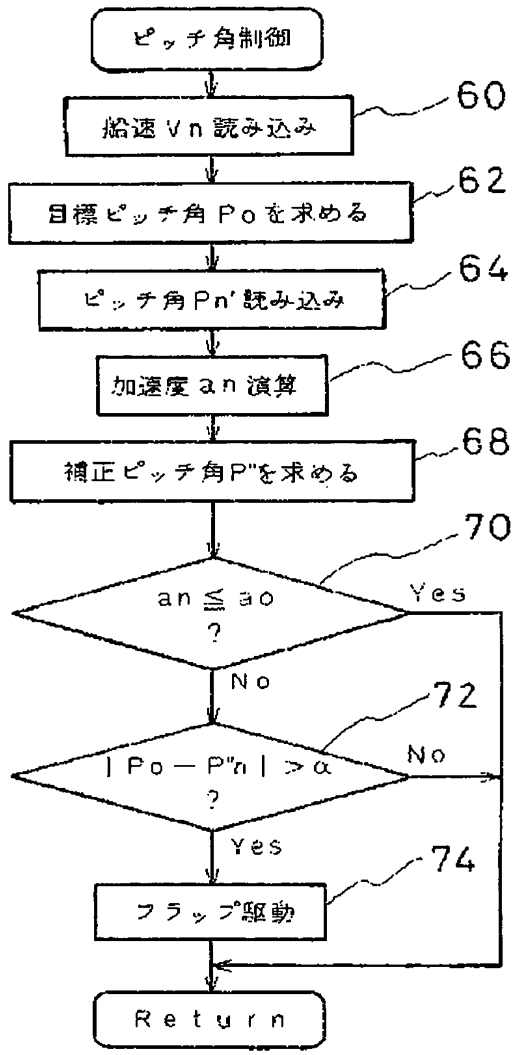
【図5】


ピッチ角制御
船速Vn読み込み
20
目標ピッチ角Poを求める
22
ピッチ角Pn'読み込み
24
加速度an演算
26
補正ピッチ角P"を求める
28
30
｜Po－P"n｜＞α
?
No
Yes
32
フラップ駆動
Return

【図6】


ピッチ角制御
船速Vn読み込み
40
目標ピッチ角Poを求める
42
ピッチ角Pn'読み込み
44
加速度an演算
46
補正ピッチ角P"を求める
48
加速度係数kを求める
50
P'''n = ((k−1)P'''n-1 + P"n) / k
52
|Po−P'''n| >α ?
54
No
Yes
フラップ駆動
56
Return

【図8】



フロントページの続き

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